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IL-76 Candid: Status and Outlook for the Soviets' Major Transport Aircraft Program

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A Research Paper

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IL-76 Candid: Status and Outlook for the Soviets' Major Transport Aircraft Program

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A Research Paper

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The authors of this report are

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[redacted] Office of Soviet Analysis, and [redacted]
[redacted] Office of Scientific and Weapons Re-
search, contributed to this report.

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Comments and queries are welcome and may be
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IL-76 Candid: Status and Outlook for the Soviets' Major Transport Aircraft Program

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Summary

Information available as of 1 December 1985 was used in this report.

The Soviet IL-76 transport aircraft—codenamed Candid by NATO—forms the backbone of the Soviets' military air transport assets and will continue to do so into the next century. It is similar in mission and design to the US C-141, but can carry a greater payload, although to a lesser range.

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The IL-76s assigned to the military are replacing the older and less capable AN-12 aircraft in Soviet Military Transportation Aviation, the Soviet equivalent of the US Military Airlift Command. By 1992, we project that all military AN-12s will have been replaced by IL-76s, providing Soviet Military Transport Aviation with a fleet of some 440 of these aircraft. (By comparison, some 285 C-141s were produced for the US military.) The primary mission of the aircraft is to provide the airlift for Soviet airborne forces. Compared to the capabilities of an AN-12, an IL-76 can carry a greater variety of equipment, can carry over twice the weight, and can carry that weight twice as far at a third higher speed. These capabilities enable the Soviet airborne forces and their equipment to be delivered and resupplied, without refueling, to almost all of Europe, North Africa, and the Middle East. The IL-76 also increases the Soviets' ability to conduct massive airlifts to client states throughout the world.

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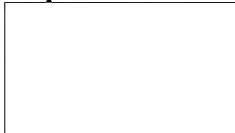
[redacted] AWACS variant and an in-flight refueling tanker variant of the IL-76 began [redacted]

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[redacted] cause of the growing Soviet need for these special-purpose aircraft, we estimate they will produce at least another 25 AWACS and 70 to 80 more tankers. The AWACS variant provides the Soviets with a sophisticated radar capable of tracking low-flying targets and directing Soviet fighters to intercept them. The AWACS is the only IL-76 with an in-flight refueling capability and will probably

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be refueled by IL-76 tankers. IL-76 tankers will probably be produced in sufficient numbers to support strategic bombers and tactical fighters as well. [redacted]

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Based on our estimate of the Soviets' requirements for IL-76 aircraft, we believe they will probably produce 280 to 330 more aircraft, making a total production run of 750 to 800. The Soviet military will continue to receive most of these aircraft. We estimate current production to be 60 aircraft per year, and our analysis [redacted]

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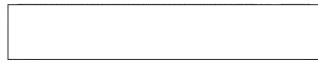
[redacted] indicates that this figure is at or very near the peak of production. We expect this peak rate to be maintained for only a year or two longer before production begins to taper off. The decline will probably be caused by diminishing requirements for standard IL-76s, increasing production of the more complex AWACS and tanker variants, and the beginning of major component production for the new heavy transport aircraft, the AN-124. We estimate that about three to five AWACS and about six to eight tankers will be produced each year until Soviet requirements for these variants are satisfied. We expect that civil and export models, as well as additional variants, will also continue to be produced. [redacted]

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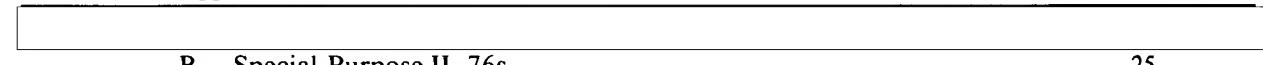
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Scope Note

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This paper presents a comprehensive discussion of the Soviet IL-76 Candid transport aircraft program. It describes the capabilities of this aircraft, discusses its primary role as a military transport, and addresses the more recent development of AWACS and in-flight refueling variants.

[redacted] projections are made of IL-76 requirements into the 1990s.

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IL-76 Candid: Status and Outlook for the Soviets' Major Transport Aircraft Program

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Introduction

As the Soviets rebuilt and expanded their economy and military forces in the decades following World War II, the need arose for larger and more capable transport aircraft. Transports were needed that would be large enough to carry construction equipment and supplies to growing communities and resource exploration sites in the Soviet Far East and Siberia, and to move Soviet airborne troops and their equipment to potential conflict sites beyond the homeland borders. The inspiration for an aircraft to fulfill this role came during the early 1960s with the development of the US Lockheed C-141 Starlifter. This new US aircraft stimulated Soviet interest in a new transport, and

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The Soviet aircraft was similar in size and general appearance to the C-141 and incorporated many of its design features. Some features, however, were altered to conform to Soviet production capabilities or to better satisfy Soviet user requirements. Five prototype aircraft, designated IL-76 by the Soviets and Candid by NATO, were built between 1969 and late 1972. The first of these had its initial flight in late 1970 and was shown at the Paris Air Show in mid-1971.

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The Soviets have invested heavily in resources that appear dedicated to a long production run of the IL-76. Apparently the aircraft has performed satisfactorily and will probably fulfill most of the Soviets' military transport requirements and many civil requirements into the 21st century. Two variants of the IL-76, an AWACS and an in-flight refueling tanker, have only recently entered series production; it is unlikely that the military requirements for these aircraft will be satisfied until the early 1990s.

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USSR and in the Third World. [redacted]

have reinforced cargo floors for heavy equipment and pressurized cargo compartments for transport of personnel or paratroops. [redacted]

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In appearance and size the IL-76 is much like its US counterpart, the C-141 (figure 1). While the Ilyushin Design Bureau obviously borrowed heavily from the Lockheed C-141, they did not simply copy it. The IL-76 fuselage diameter is greater than that of the C-141 to accommodate wider equipment; its landing gear is heavier for rough field use; and it can carry a larger payload, although to a lesser range. Table 2 lists the known characteristics and capacities of the IL-76 and compares them with those of the C-141. [redacted]

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Candids initially were designated IL-76 and had a maximum takeoff weight of 157,000 kilograms. Later Candids—IL-76T and IL-76M—have maximum takeoff weights of 170,000 kilograms, with the weight increase due to a larger fuel capacity. The early IL-76s are now being retrofitted to have the 170,000-kilogram gross weight and increased fuel load. Within the last few years, two additional types of Candids have entered production—the IL-76TD and IL-76MD. These newer variants reportedly have an additional increase in fuel capacity and a heavier maximum takeoff weight of 190,000 kilograms. [redacted]

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The range and payload capabilities of the IL-76 are greatly superior to most Soviet cargo transport aircraft. Only the old AN-22 (Cock) and the newly designed AN-124 (Condor), not yet in production, can lift more cargo and carry it farther. There are more than six times as many IL-76s as there are AN-22s available for airlift operations. The IL-76 force is thus the primary vehicle for air transport and enables the Soviet airborne forces and their equipment to be delivered and resupplied to almost all of Europe, North Africa, and the Middle East. [redacted]

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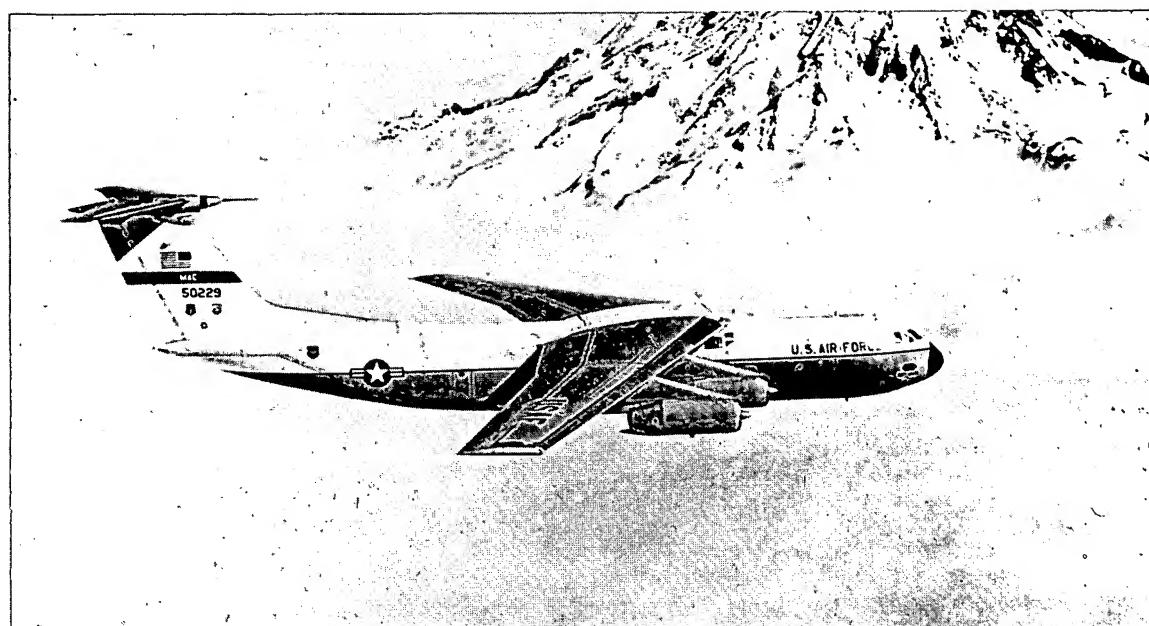
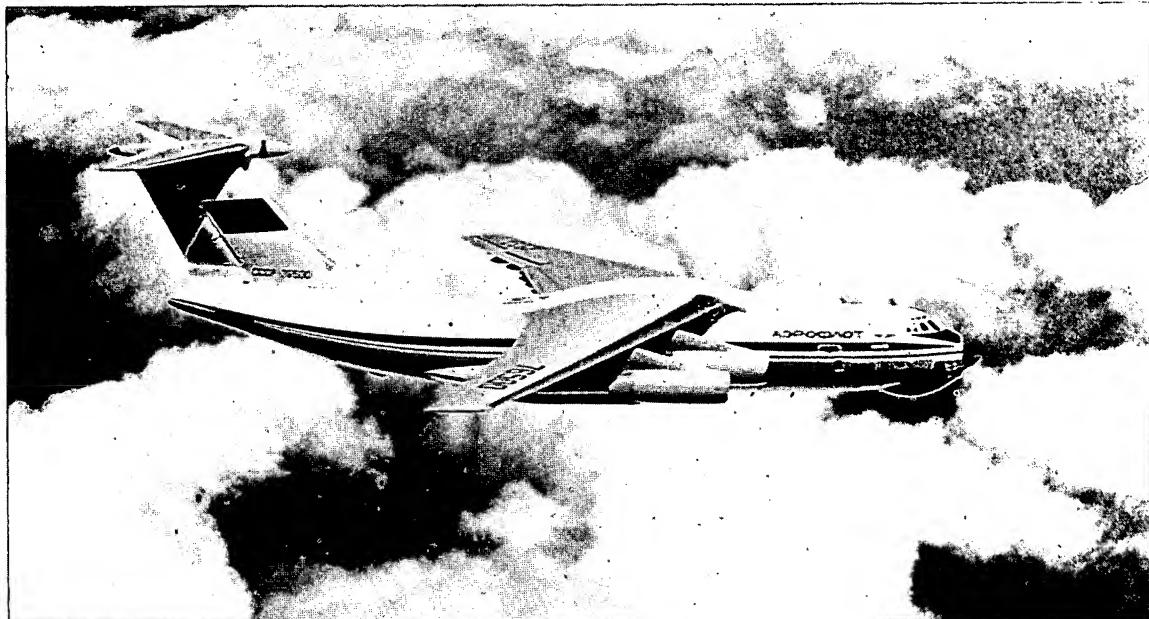
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Figure 1
Soviet IL-76 and US C-141 Transports



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Table 2
Aircraft Characteristics and Capacities

	IL-76T and IL-76M	C-141B	Cargo Compartment	IL-76T and IL-76M	C-141B
Dimensions					
Length	46.6	51.3	Length (excluding ramp)	19.7	27.7
Height	14.75	12.0	Height	3.5	2.77
Wing span	50.5	48.8	Width	3.45	3.12
Wing area (square meters)	329	300	Ramp Length	9.4	6.0
Wing sweep (degrees)	27	27	Ramp Width	3.4	3.1
			Ramp Slope (degrees)	10	15
Power Plant					
Manufacturer	Soloviyev	Pratt and Whitney	Maximum takeoff (kilograms)	170,000 ^d	155,600 ^b
Engine Model	D-30KP (four)	TF 33-P-7 (four)	No payload (kilograms)	IL-76T: 82,000 ^d IL-76M: 86,000 ^d	65,500
Thrust rating (kilograms)	12,000	9,530	Maximum payload (kilograms)	40,000 ^d	42,900 ^b
Specific fuel consumption at takeoff (kilogram/ kilogram/hour)	.50-.55	.56	Maximum fuel (kilograms)	84,500 ^d	69,600
Performance					
Cruise speed (kilometers/hour)	750-800	750-785	Crew	5 to 7	4 (plus 4 alternate)
Cruise altitude (kilometers)	10-13	10-12.5	Troops	140 ^e	209
Range with maximum payload (kilometers)	IL-76T 4,400 IL-76M 4,000 ^a	4,600 ^b	Paratroops	125	168
Take-off distance ^c	2,300	2,000 ^b	Litters	72	108

Note: Undefined measurements are in meters.

^aThe IL-76TD and MD variants have roughly a 1,700-kilometer greater range.^bThis number is for a G-load factor of 2.25. At a 2.5 G-load factor the range would change to 5,100 kilometers and the take-off distance to 1,800 meters. Takeoff weight would decrease to 146,600 kilograms and payload to 33,700 kilograms.^cCalculated at sea level, with maximum weight, to clear a 15-meter height at end of runway.^dThe IL-76TD and MD variants have a maximum takeoff weight of 190,000 kilograms. Maximum fuel weight is estimated to be 90,500 kilograms and maximum payload at least 50,000 kilograms. Maximum landing weight may also have increased. The operating weight when empty is probably somewhat greater than that of the IL-76 and IL-76M.^eCapacity is 225 people if the plane has a double-deck configuration.**Top Secret**

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**Soviet and US Production:
Major Differences in Philosophy**

The IL-76 production rates, while fairly representative of Soviet aircraft production, are dissimilar to the rates found in a profit-oriented market such as the US industry. Contrasting the IL-76 and its US lookalike, the C-141, reveals some of the major differences in production philosophy:

IL-76

- 470 built between 1974 and late 1985; average 39 per year.
- Overall number likely to increase by 65 percent as production continues into the 1990s.

C-141

- 285 built between 1963 and 1965; average 95 per year.
- 270 of the original C-141s were modified between 1979 and 1982 to extend their role life.

The number of IL-76s built by the Soviets in the first nine years of production is similar to the number of C-141s built by the US in three years. The US manufacturers, responding to US Air Force procurement allowances for these three years, began a high-volume, mass production program. In contrast, the Soviets—working with long-term central planning cycles, quota systems, parts supply difficulties, and antiquated manufacturing machinery—have opted for a long and steady production run.

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The increasing output of IL-76s over the past decade can be represented graphically by means of a "learning curve." In a mass production program for complex items such as an aircraft, administrative, delivery, and assembly procedures should become more efficient over time, reducing the effort and cost of later units. This movement toward increased efficiency can be plotted and used to describe and predict production output at various points during a production program. The increase in output of IL-76s since 1974 shows such a trend towards increased efficiency and correlates with a 76-percent learning curve (that is, only 76 percent of the time is needed to produce the 200th plane as was needed to produce the 100th plane).

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[redacted] the increase in output since that time is adequately explained as a function of the learning curve. A later section of this paper will return to these factors and the potential they have in helping predict future IL-76 output.

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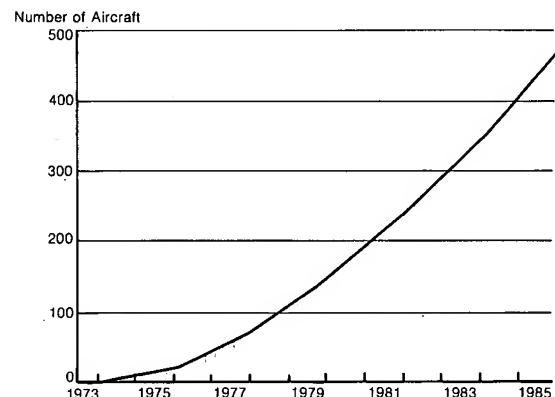
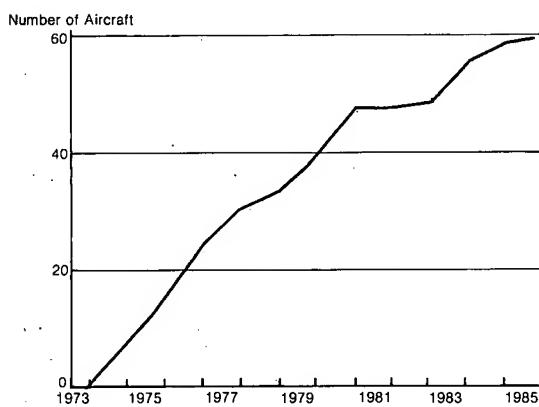
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Figure 2
IL-76 Production, 1973-85

Rate of IL-76 Production

Cumulative IL-76 Production

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Deployment

During the first two and a half years of production, all IL-76s (about 35 aircraft) were delivered to the Soviet military. Since then, allocations of newly produced IL-76s have gone to other customers as well as the military, and the allocation ratios have remained fairly constant throughout the production run. About 70 percent have gone to the military, 11 percent to Soviet civil aviation (Aeroflot), 12 percent have been exported, and 7 percent have been modified for special roles. Of those IL-76s modified for special roles, two variants—an AWACS and a refueling tanker—have recently been developed into production models, but only a few have been produced so far.

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The IL-76 has been a reliable aircraft, and at least ninety-eight percent of those produced are still operational.

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Military Aircraft

The primary customer for IL-76s has been Soviet Military Transport Aviation (Voyenno-Transportnaya Aviatsiya—VTA), the Soviet equivalent of the US Military Airlift Command (MAC). By late 1985, we estimate 330 military IL-76s had been produced.

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The Impact of IL-76s on Soviet Airborne Forces

The IL-76 brings capabilities to Soviet military transport service that are significantly greater than those of the AN-12. An individual IL-76 holds, roughly, twice as much cargo as the AN-12 and can carry it twice as far at a third higher speed. For the VTA, the principal user, the IL-76 offers many improvements over the AN-12. A regiment of IL-76s can carry about 560,000 kilograms (50 percent of its maximum payload) up to a distance of 6,500 kilometers in a single airlift. (The IL-76 TD and MD variants can travel over 7,500 kilometers with the same weight.) An AN-12 regiment is able to move only about 350,000 kilograms (50 percent of its maximum load) a distance of 3,300 kilometers. In an airborne role, compared to the AN-12, the IL-76 can:

- *Carry three rather than two BMD armored personnel carriers.*
- *Carry 125 rather than 60 paratroopers.*
- *Carry its passengers in a pressurized cabin, rather than requiring individual oxygen supplies because of unpressurized cabins.*

Concurrent with the upgrading of the VTA with IL-76s, there has been a modernization of the Soviet airborne forces. They are being equipped with larger numbers of new, air-transportable weapons and vehicles, which require the greater lift capability of the IL-76 regiments.

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76 regiment, however, is roughly double that of an AN-12 regiment.

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The replacement of AN-12s with IL-76s has not been on a one-for-one basis. An AN-12 regiment, comprising 33 to 36 aircraft, is being replaced by a regiment of 28 IL-76s.⁴ The lift capability of an IL-

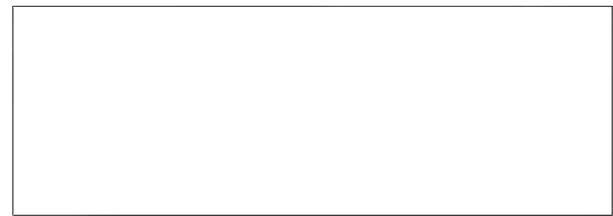
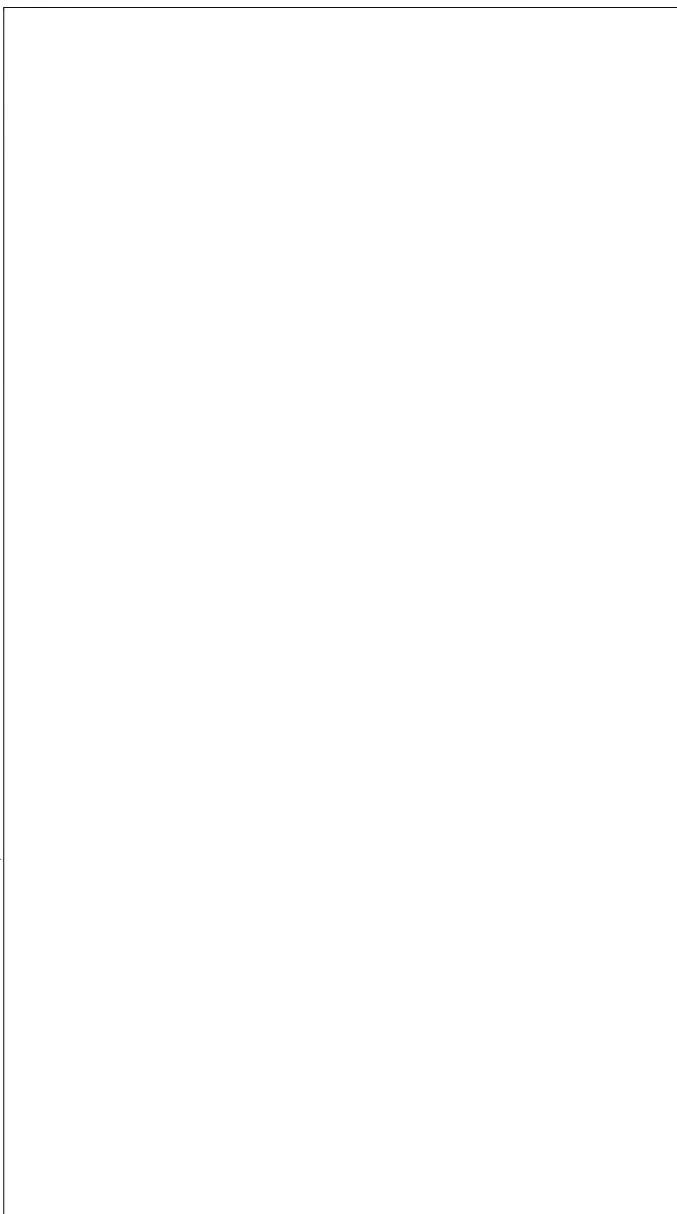
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Export Aircraft

Since 1978 the Soviets have exported 56 IL-76s. Exports include both the military and civil versions. As of late 1985, five countries had received IL-76s:

	Libya	Iraq	Syria	Cuba	India
Total	24	20	4	2	6
Military	5	10 ^a	2	0	6
Civil	19	10	2	2	0

^aOne aircraft is registered for Iraqi government use.

IL-76 sales to all of these countries are continuing

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Civil (Aeroflot) Aircraft

About 52 IL-76s have been delivered to Soviet civil aviation (Aeroflot) since 1976. Aeroflot's share of IL-76 production has averaged about five aircraft per year.

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Airborne Tanker.

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transfer 40 metric tons of fuel and then return to base. We estimate the fuel transfer rate for this system to be at least 1,500 kilograms per minute per hose.⁷

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IL-76 tankers will not be as difficult or time consuming to produce as the AWACS. Some extra steps will be required to install the pods and internal plumbing. These operations, however, should not be too difficult to implement on the existing assembly line; by 1987 we believe that six to eight IL-76 tankers may be produced each year.

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By adding a fleet of IL-76 tankers, the Soviets will greatly enhance their ability to conduct missions of long distance or long duration. Two fighter-size aircraft can refuel simultaneously from the under-wing pods. Larger aircraft will likely be refueled singly from the aft fuselage station. The IL-76 tanker appears to use the basic military version and, because of the advantages of higher gross weight and fuel load, will probably be produced with an IL-76MD airframe. Based upon this assumption, we believe the IL-76 tanker will probably have over 100 metric tons of fuel at takeoff. After flying a distance of 2,800 kilometers, it could

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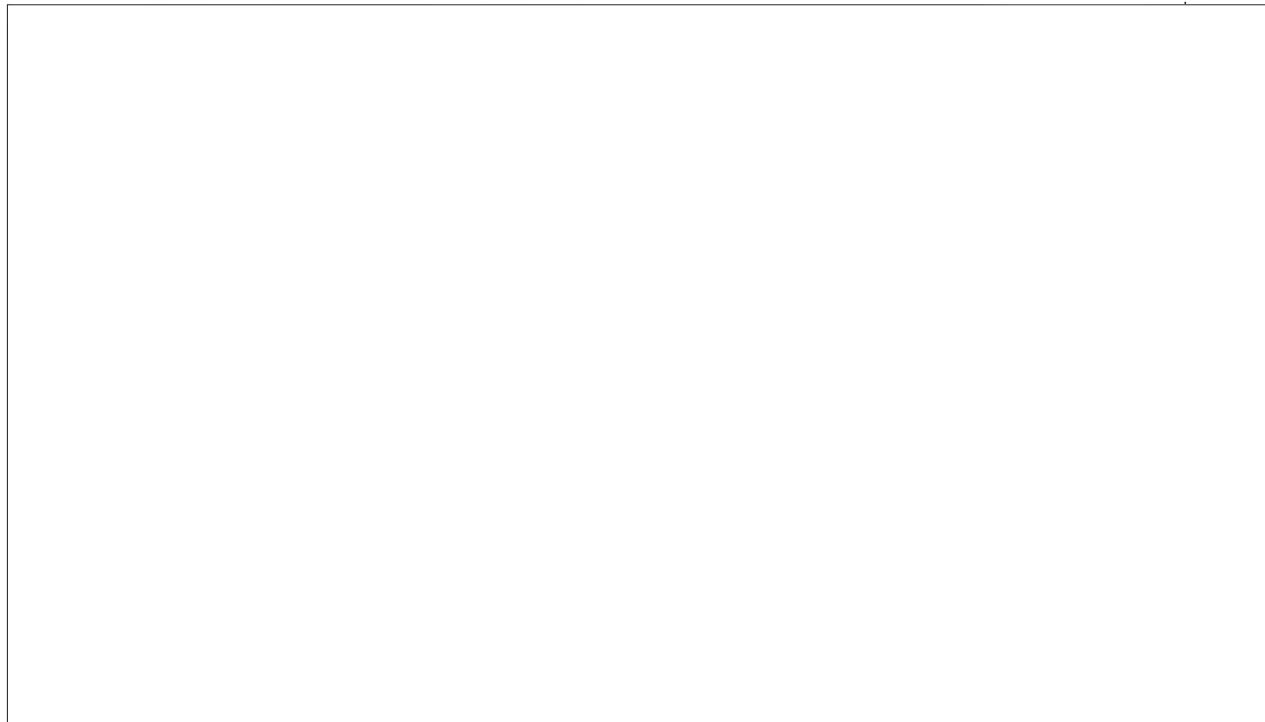
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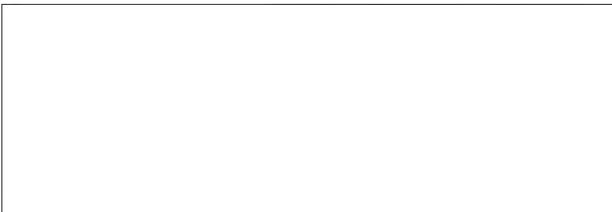
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Maintenance

With their growing fleet of IL-76s, the Soviets require dedicated repair facilities to keep these aircraft in service. Inspections, maintenance, repairs, and replacement of parts and systems are handled through regimented and predetermined schedules. A part is inspected and serviced at regular intervals, but once it has reached its safety service lifetime, it is replaced automatically (usually at a time far before it would be replaced in the US system). Aging aircraft also will require structural repairs or major maintenance that cannot be performed at the deployment bases. Thus, depot-level repair and overhaul facilities are needed for the IL-76.

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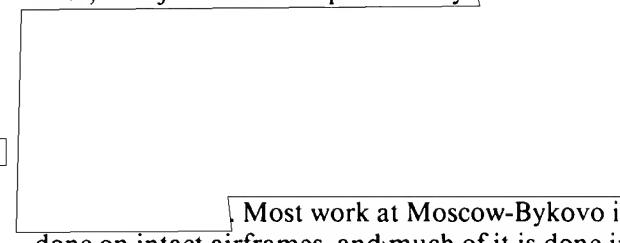


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The Soviet civil version of the IL-76 undergoes depot-level repair at the Moscow-Bykovo Repair Base, a major Aeroflot repair facility.



Most work at Moscow-Bykovo is done on intact airframes, and much of it is done in the open. This, we believe, is typical of depot-level repair functions.



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Assessment of Future Production

In order to fulfill estimated user requirements, the Soviets will have to keep the IL-76 in production until the early 1990s. By late 1985 some 470 IL-76

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aircraft had been produced. We project that at least another 300 will need to be produced to meet Soviet requirements (table 4). The VTA will continue to receive the largest share of production.

percent of IL-76 production allotted to Aeroflot and for export will probably continue at about the same rate as in recent years, or slightly lower. The requirements for these customers, however, are less defined. Once the military requirements for IL-76s are more nearly satisfied, the Soviets may try to expand their export market and perhaps add more aircraft to their civil fleet. If so, the production run could extend beyond our projections. Based upon our perception of Soviet requirements and their ability to series-produce special-purpose aircraft, we believe that the Soviets may field at least 30 AWACS and 75 to 85 tankers. We also believe the Soviets will continue to modify some newly produced IL-76s for special roles. In the late 1980s IL-76 output will probably begin to decline as VTA requirements are fulfilled and as production of the more complex IL-76s—AWACS, tankers, and electronic support aircraft—increases.

Throughout the first dozen years, increases in IL-76 production could reliably be correlated to normal progression along a 76-percent production learning curve

Dwindling
Soviet requirements for the standard IL-76 and production of the more complex variants will probably cause the learning curve projection to correspondingly level off. Peak production, therefore, for the IL-76 is probably occurring now, with the rate unlikely to be much greater than about 60 aircraft per year.

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